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The Great International Fisheries Exhibition

STORM WARNINGS

BY

Robert Henry SCOTT 1833-

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L. B.

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International Fisheries Exhibition
LONDON, 1883

ON

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R. H. SCOTT, M.A., F.R.S.

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International Fisheries Exhibition

LONDON, 1883.

CONFERENCE ON MONDAY, JULY 16, 1883.

Mr. J. K. LAUGHTON, M.A., President of the Meteorological Society, in the Chair.

STORM WARNINGS.

12-14-37

IT sounds like a truism to say that almost every trade, every occupation in life, depends more or less on the weather, but surely that of the seaman or fisherman is more seriously influenced by it than any other. Accordingly great interest attaches to the efforts which are now made in all civilized countries to convey to their seafaring population any intelligence which may be of service to it in its laborious and perilous calling.

With the view of exhibiting what is being done in this direction in various parts of the world, the International Meteorological Committee, at its recent meeting at Copenhagen, resolved, on the invitation of the Executive Committee here, to invite all Meteorological Offices possessing a storm-warning organization, to send to London specimens or models of the methods and apparatus employed by them in the service.

The result has been that for Europe, Denmark, Germany, Great Britain and Ireland, Holland, Portugal, and Russia are represented, while from the United States the Chief Signal Office at Washington has sent a full display of its appliances, which ought to put several European Governments to shame.

The most prominent exhibitors in the way of models, next to the United States, are Germany and Holland, of whose apparatus I have exhibited specimens on the table. I shall explain these subsequently.

The first idea of conveying intelligence of storms by the electric telegraph, appears to have occurred to Mr. Redfield, known as the first discoverer of the Law of Storms, in the year 1847. He was an American, and various attempts were made to carry this idea into effect at the other side of the Atlantic, before the war of 1861 put, for a time, a stop to all such progress.

In Europe, Leverrier was the first in the field, and in February, 1855, he obtained the Emperor's sanction for the creation of an extensive organization for the purpose of distributing weather intelligence over the countries taking part in the scheme.

The fact that the well-known Balaclava storm of November 14, 1854, had travelled along southern Europe before it burst upon the allied fleets on the Crimean coast, was that which decided Leverrier on carrying out the experiment, but it was not until five years later, in the spring of 1860, that he felt himself in a position to invite other countries to join in the scheme.

His letter to Sir G. Airy, of that date, contains the following expressions, which now, at the end of three and twenty years, represent fairly enough the conditions of storm warning.

"The ultimate result of the organisation which we are establishing should be to announce a storm as soon as it appears at any point in Europe, to follow it on its course by means of the telegraph, and to give timely notice of it to the coasts which it may reach."

My audience will see that this programme contains no idea of prophecy, nothing but a statement that a telegraphic message would travel faster than a storm, and that warnings of the storm could therefore be sent. In this country the idea of storm warnings had been ventilated before 1860, for the British Association at their Aberdeen meeting in the previous year, under the presidency of the late Prince Consort, had passed a resolution in favour of their introduction. A month after the meeting the loss of the *Royal Charter* on the north coast of Anglesea attracted universal attention, and from the circumstances of that case the public drew the hasty conclusion that no storm could ever come on without giving timely indication of its approach. Before I have done I shall hope to show how unsafe such a generalization was and is.

Early in 1861 the first tentative warning was sent out in this country, and by the spring of 1862 Admiral Fitz-Roy's system was definitely established. The admiral, however, as is frequently the case with enthusiasts, tried to run before he could walk, and issued warnings to cover an interval of three days, a period now universally admitted to be too long, but, with this exception, the mode of conveying intelligence, devised by him at the outset, was so sound and practical that it has met with general acceptance, in Europe at least.

The basis of his signal system was the employment of solid figures, what are called, mathematically, solids of revolution, to convey his messages. The use of flags was objectionable, as these are employed for many other purposes besides storm signalling. Of such solids there are three simple forms, the sphere, or *ball*, the cylinder, or *drum*, and the *cone*. If any of these are hoisted on a flagstaff they will always present the same form to the eye at a distance, no matter how they are blown about. The ball will be a circle, the drum a rectangle, and the cone a triangle.

Of these forms the ball was already pre-engaged, at least in our harbours, e.g., for conveying tidal signals as to the height of water on a bar. Admiral FitzRoy, however, adopted the two others.

With him, the cone, point upwards, indicated a gale from a northern point; reversed, it showed that the gale was to be expected from a southern quarter, and the drum announced "dangerous winds from opposite quarters successively."

In this country the use of the drum has been abandoned, as it was found that little practical advantage could be gained from it. Our area is so small that we generally have only time to announce the existence of a storm, without attempting to indicate its probable violence—a quality only to be learnt from reports of its effects.

The cone and drum, in various combinations, are the signals used throughout Europe generally, except in Holland, and the drum is employed to emphasize the cone, to show when a very severe storm has been already reported from the outlying stations. My audience will remember that for such information ours are the outlying stations for Central Europe and North Germany at least, the storms striking the coast of Ireland or Scotland first.

The Dutch system is on a totally different plan, and in order to explain it I must enter into a brief account of some simple meteorological principles.

I suppose that all of my hearers have at least learnt from the daily reports in the newspapers that storms do not depend on the actual height of the barometer at any time at any one station, but on the difference between the simultaneous readings at adjacent stations, on what is called *the gradient*, the difference between barometrical readings over a given distance, say fifty miles.

This will best be understood by reference to a diagram of one of our severe storms. The lines on such a diagram are called isobars, and they represent lines of equal barometrical readings. Where such lines are closely packed together there are great differences in barometrical readings for the unit of distance, that is, there are high gradients, and consequently strong winds. Where the isobars are far apart there is little difference in readings for the unit of distance, and the winds are light.

In every case also the wind blows so as to have the lowest barometer on its left hand side, in this hemisphere, and its force is more or less proportional to the gradients.

It is on this principle that the Dutch mode of weather signalling is based, and this is essentially not a mode of storm warning. The inventor of the apparatus, called the Aeroklinoscope, is Professor Buys Ballot, of Utrecht, and he has formulated the principle which I have mentioned, into what is known as his Law, which for the northern hemisphere runs thus.

"Stand with your back to the wind and the barometer will be lower on your left hand than on your right."

The apparatus consists of a bar or cross piece like a ship's yard, hoisted on a mast, which can be swung round so as to point in any direction, and can be peaked to any reasonable extent.

It is erected at the ports in Holland, and is set every day according to the weather reports, and according to the barometer readings taken that morning over the kingdom.

It is set so as to point from the highest to the lowest barometer readings, and the angle at which it is set indicates the amount of difference between those readings.

Accordingly if the seaman looks at the apparatus he sees from what point the wind will blow during the day, and can form some idea of its probable force.

It will be seen therefore that the system is intended for daily, not only for occasional use. The idea is theoretically good, but practically it is not easy, if you are at a distance, to make out which end of the cross-bar is nearest to you, or whether you are in front or at the back of the apparatus. To aid you the two ends of the bar are marked differently, and the two sides coloured differently; but it is not easy to make out the colours at a distance.

In the United States the system is different from anything we have in Europe. There flags are used, a red flag with black square or a red lamp at night, indicating dangerous winds from any direction, and a white flag with black centre, or a white lamp at night, indicating dangerous *off shore* winds, i.e., winds from north and west, and a ball is hoisted to show that storm warning of some sort or other has been issued. I may say, *en passant*, that it seems a little remarkable that storm signals are hoisted at 111 stations only over the whole United States, while we in these islands have nearly 140 for a much smaller area.

Having thus said something about the apparatus employed to communicate storm warnings, let me now proceed to explain what meteorologists are able to convey by its use.

I suppose that all of my hearers have read enough of late years about depressions, which always bring bad weather, storms in winter and rain in summer. Now I do not mean to say that all our storms are due to depressions, but by far the greater part of them are so, and for the purposes of this lecture I shall only treat of such storms.

What, then, is a depression, or a cyclonic disturbance? it is a portion of the atmosphere in motion more or less approximately circular, round a central point. At this central point the barometer is lowest, and, in this hemisphere, the air is moving in the direction against watch hands, or in accordance with the Buys Ballot's law just explained, and the clouds and weather are distributed according to known laws, which have been explained by various authors.

Now for the purposes of storm warning, in its simplest conception, we have only to recognise the existence of these depressions, and you must take it on my word that they generally move over the earth's surface, and in these latitudes usually advance from west to east.

The rate of advance varies from, say, ten miles an hour to as much as sixty or seventy miles an hour, a rate which has been proved to have existed in certain storms crossing the North Sea.

When therefore one of these depressions appears on our coasts, and not till then, can we venture to announce its proximity by our warnings.

We can only learn the fact of its existence from our reporting stations, and these are represented on the map which I exhibit. A glance at this will show how "few and far between" these are on the west coasts of Ireland and Scotland.

These are the most important districts in Europe for gaining early intelligence of weather changes, but in the first instance telegraphic communication is only very scantily developed in such wild regions, and in the second place the habitable spots are all in sheltered bays, where the true force of the wind is not felt, owing to the fact that few ordinary houses could bear the brunt of an Atlantic winter gale. The observers therefore are unable to send us up perfectly true reports of the direction and force of the wind.

A great deal is said about our obtaining reports from Newfoundland, or the United States of America, the Azores, the Faroes and Iceland, and lastly from moored signal ships. Reports from the other side of the Atlantic would certainly be valuable if we could obtain them cheaply, but the difficulty would be in knowing how to make use of them, for though storms do cross the Atlantic from shore to shore, they change their character *en route*, some increasing and others dying out, so that from the reports from America alone, we cannot foresee which storm out of several starting successively from the States, or Canada, will reach us.

My hearers will of course expect to hear something of the *New York Herald* warnings, which we owe to the well-known public spirit and liberality of Mr. Bennett, and which appear so frequently in the newspapers. It is however not possible to discuss these communications here, because the mode of preparation of the warnings has never been published. In no instance have the precise facts which led to the issue of one of these warnings been communicated, at least to our office, so that we could form a judgment as to whether the same data would have induced us to issue a warning.

As to the Azores or the Faroes, no cable has yet been laid to either group of islands, and it does not seem likely that any will soon be in existence; for the expense of an ocean cable is so great, that there is no chance of its being a paying speculation unless it holds out prospects of considerable commercial utility. These cannot be put forward in either of the cases cited, for no great trade exists on those lines. To give an idea of the amount of money required to lay and maintain such a cable I may say that one project required a guarantee of international support from all the Meteorological offices of Northern Europe, the quota from this country for three daily reports being £3,000 a year, one-fifth of our annual grant from Parliament. It is therefore evident enough that for the present we must give up the immediate prospect of Atlantic island stations.

As to news from the surface of the Atlantic itself, the idea of mooring ships and connecting them by telegraphic cable with the shore, has been often mooted, and there is a plan for it in the present Exhibition, but it has never been carried into practice; and until the lighthouse authorities have established telegraphic communication with their light ships, we need not expect to establish it with a ship in mid-ocean, even if we could succeed in mooring and keeping her there.

To give an idea of the extent to which storms striking our coasts could really be predicted by means of reports from America, my friend Captain Hoffmeyer, the head of the Danish meteorological service, who has published daily weather maps of the Atlantic for the space of three and a quarter years, in a pamphlet which appeared in 1880 investigated the courses of Atlantic storms. He discussed 285 depressions in all, covering an interval of twenty-one months, and found the following percentage proportions :—

Source of Depression.	Existing in Long. 40° W.	Passing Long. 10° W.
Arctic regions	8	6
North America	44	24
Probably tropical	9	2
Arising at sea	37	16
Untraceable	2	2
	100	50

You will therefore see that only half of the disturbances which appear in mid-Atlantic live till they reach the Irish coast, and that only one quarter of the storms which visit us ever come from the States or could possibly have been telegraphed from thence.

The large diagram which I exhibit, and which has been drawn by Dr. Köppen of the Hamburg Meteorological Office, shows the districts of maximum frequency of depressions over the Atlantic, on the average of the year. It will be seen from this that a broad belt extends from 40° N. over the eastern States and out as far as Newfoundland. If the map were extended westwards we should find this belt stretching back to the Rocky Mountains. After passing Newfoundland the belt becomes narrower and trends north-eastward, till it touches the permanent Icelandic depression, which exists in the north Atlantic during the greater part of the year. From this point it throws out an arm into Davis's Straits. The main stream, however, passes on, and on the Scandinavian coast forks, one maxima lying near the Loffodens, the other over the southern Baltic.

It is to this general direction of the mean path of depressions that we owe our prevalent south-westerly winds. If the track in our neighbourhood is from a northern point, down the North Sea, we have our northerly winds and cold weather. If it lies along the Channel or over France we have our easterly winds, such as visit us in spring.

Having thus given you some slight idea of the origin of our storms, and of the courses by which they arrive on our shores, I must now say something of the extent to which we succeed in giving timely warning of their approach to our fishermen and coasting seamen.

It must always be remembered that in order to issue perfectly correct storm warnings, we should require to know the size, shape, position and motion, in direction and rate, of an advancing depression, and also whether it is becoming deeper or the contrary; and that there is not one of these conditions of which we have a really sufficient knowledge at present, while of most of them we can have no knowledge at all till the storm has burst upon us.

The problem, which is put before us daily, is similar to one which astronomers would at once recognise as one impossible of solution, and that is to determine the elements of a comet's path from a single observation taken, say, in a brief clear interval on a cloudy night. The first glimpse we get of a storm must suffice for us to issue our warnings. It is therefore evident that for our own exposed western and north-western coasts we can but rarely issue timely warning; but, fortunately, these iron-bound shores are not frequented by an amount of coasting craft at all commensurate with that navigating the comparatively calmer waters of the two Channels and the North Sea.

The results of the warning to our own coasts have been printed for many years, at first as a Parliamentary Paper, and latterly in our own Reports ; and the following Table gives a summary of the figures for the whole period :—

—	Warnings justified.		Warnings not justified.	Warnings.		Warnings issued in error.
	By Gales.	By strong winds.		Late.	Partially late.	
1870–75 .	47·6	26·8	18·4	1·5	3·8	1·9
1876–81 .	56·4	23·5	15·8	0·8	3·1	0·3
Average .	52·0	25·1	17·1	1·2	3·5	1·1
1882 . .	61·4	21·1	14·9	0·4	1·6	0·6

It will be seen that a decided improvement took place in the year 1876, coincident with the introduction of an evening telegraphic service—a step in advance which we owed to the liberality of the *Times* newspaper. The last year, 1882, shows a decided advance on the figures for the previous period.

It appears from these figures that more than half of the signals of approaching storms were fully justified. It is therefore evident that the organisation of storm warnings renders it possible to give useful intelligence to the coasts, but it need hardly be said that, for these islands, the system is rather of the "from hand to mouth" type, and that our warnings would be far more useful if they could be issued sooner, so as to render it possible for captains to get information of a coming gale before leaving port.

The table and diagram do not give any indication of the storms of which no warning was given, and of these there have been instances in every year. I fear that we cannot at present hold out hopes of being able to show a blank failure column in our yearly analysis. The instances of such failure are not frequent, but they are sometimes serious, as some of our worst storms occasionally give very slight indications of their proximity by instrumental readings.

I have represented on the screen a recent instance of this, the storm of October 24th, 1882. You will see that the map for 6 P.M. on the evening before showed, in its barometrical indications and its wind reports, not a sign of the disturbance which lay over the west of England at 8 o'clock in the morning.

Similar instances might easily be cited, and others arising from miscalculation of the path which the storm was following, but the time would fail me were I to continue the subject further.

There is, however, one point to which I ought to allude before I have done. It may seem strange that when a storm made its appearance in the night time, like that of October 24th just cited, I should have said nothing about the possibility of receiving intimation of it by means of later, say midnight reports, and distributing the news to the coast stations at once.

The explanation of not doing so is, that though we might organise night reports, the only portion of the population who could benefit by them would be the readers of newspapers. We could send forecasts to the press at a later hour than 9 P.M., but we could not send warnings to the fishermen on the coast; and it is for them in the first instance that the warnings are meant. The local telegraph stations close at 8 P.M. at latest, and so the messages could not possibly reach the coasts before about 9 A.M. next day, when, as will be seen by the map, they would have been too late for the coasts of Devon and Cornwall.

The development of our storm-warning system is regulated mainly by the completeness of our telegraphic arrangements. If the fishing villages were all telegraphic stations, and were all open all night long, we might be able to communicate to them the fact of a storm having appeared, as soon as we ourselves had learnt it, but the nature of our communications being such as it is, we must only make the best use we can of the facilities we possess and of the funds we are able to devote to the service. If the funds were increased more telegrams could be received, more warnings issued and more work done.

It would doubtless be of interest to my hearers had I time to treat of the scientific aspects of the question of storm warning, of the observations taken, of the discussion to which they are subjected, and of the efforts we are making to improve and accelerate the service, but such a lecture would be hardly suited to a general audience, as for it I must presuppose a more intimate acquaintance with the technicalities of meteorological phraseology than can usually be expected. I must therefore only conclude with the hope that I have shown you that in most countries endeavours are made to utilise, for the benefit of the fishing and coasting population, the most recent discoveries and developments of meteorological science, and that the outcome of these efforts has been unquestionably the saving of life and property to a very large extent.

When, seventeen years ago, the issue of storm-warnings was temporarily suspended by the Government, the outcry from the fishing population was too serious to be disregarded, and the service was soon re-established.

In the course of the year 1881 the Meteorological Council addressed a circular to all their storm-warning stations in order to obtain expressions of local opinion as to the value of the warnings. The replies, 135 in number, were, with few exceptions, unanimously favourable, and showed that during the twenty-three years of its existence in the United Kingdom, the storm-warning system created by Admiral FitzRoy, and carried on successively by the Meteorological Committee and the Meteorological Council, has certainly not lost its position in the estimation of the British fishing population.

DISCUSSION.

Mr. **MILNE HOME** congratulated the Executive Committee on having secured the services of so able an exponent of this subject, for no one could have been selected who was better acquainted, either scientifically or practically, with storm warnings than Mr. Scott. He would not attempt to follow him in his explanation of cyclones and other storms, but would say a word as to the extreme value of these warnings to his countrymen in Scotland, especially the fishermen who inhabited the part of the coast where he resided. In October, 1881, there was a tremendous hurricane, which destroyed the whole fleet of fishing vessels belonging to Eyemouth, and the destruction both of life and property was so great that the sympathies of the whole country were aroused, and a fund of £50,000 was raised to maintain the families which had been left destitute. It was certainly to be regretted that these forecasts of approaching storms were not more generally known along the coast, but Mr. Scott had explained the difficulty. About twenty years ago he was the means of establishing a large barometer at Eyemouth, and explaining the conclusions to be drawn from it; the fishermen of the town generally availed themselves of it, but unfortunately at the time this great gale occurred there was one young fisherman who disregarded the warning which induced the older men to stay at home, and he put out in his boat; the others felt ashamed not to follow him, and the consequence was that nearly one hundred fishing boats put off into the North Sea, and met with the disaster which he had mentioned. He believed that barometers were now generally established in fishing villages, but it was much to be regretted that there were so few stations on the western coast for affording intimation of storms. Mr. Scott had mentioned there was no station between Stornoway and Ardrossan, a distance of about two hundred miles. Ben Nevis was the highest mountain in Great Britain, and the Scottish Meteorological Society were now endeavouring to raise a fund to establish a permanent observatory on that important point. He was happy to say that out of £5000 necessary, £4000 had already been raised, he having obtained within the last few days a considerable subscription from the Corporation of London, and he trusted this example would be of service in obtaining the remainder of the sum. He was aware of the proposal to establish moored ships in the Atlantic from which signals might be sent, but, as his brother, Admiral Milne, had pointed out, it would be practically impossible to moor a vessel with an iron cable in 1200 fathoms. There was however a rock called Rockall, about two hundred miles from the west coast of Ireland, a most dangerous rock, upon which, if a lighthouse were erected, it would be of service, not only in preventing shipwreck, but also in forwarding signals.

Mr. SHEWARD concurred in the suggestion just made. Not long ago a most destructive storm visited London, of which no warning whatever had been given, which he attributed to the absence of signal stations farther west. If earlier signals could be obtained from the Atlantic an enormous amount of life and property might be saved. He was there not long ago, and noticed that about ten miles from the west coast of Ireland there was a sort of table land where the water was only 900 ft. in depth, and it appeared to him it would not be difficult to moor a vessel there.

Mr. BIRKBECK, M.P., proposed a vote of thanks to Mr. Scott for his admirable paper, which would be, when published, of the greatest value, not only to the fishing, but also to the shipping interest. Living on the east coast of England, he knew full well how often fishermen were prevented going to sea in the face of an impending storm by these warnings from the Meteorological Office, and he could only hope that the system would be very much extended.

Mr. ABERCROMBIE, in seconding the motion, said there was one point to which Mr. Scott had not done justice, and that was the enormous amount of work which he himself, in an unobtrusive way, had performed in the Meteorological Office, and the researches in which he was continually engaged with a view of increasing the already large number—about 83 per cent.—of successful predictions. There was no doubt that though this success was very gratifying it would continue to increase from year to year.

The CHAIRMAN, in putting the motion, said he could speak from personal knowledge of the great care, energy, and industry of the officials in the Meteorological Office. The difficulties they had to contend with were very great, owing mainly to the financial question, which was, from the peculiar circumstances, almost impossible of solution. It was practically impossible, on financial grounds, to keep telegraph offices open all over the country day and night, by which means alone could the desired end be attained, and it was impossible for the same reason to establish a telegraph office at every fishing station, or along the west coast of Ireland. There was one way in which the present system might be supplemented and strengthened, and that had been referred to by Mr. Milne Home. For two years past observations had been carried out by the Scottish Meteorological Society on the top of Ben Nevis, and they were endeavouring to make the system permanent. It was not known to all present, perhaps, that the storm warnings in the air were somewhat earlier in the upper regions of the atmosphere than at the surface; the disturbance occasioned by a cyclone was to some extent tilted forwards, and the upper part travelled considerably in advance of the lower. From this cause an observatory on Ben Nevis would be equivalent to one several degrees farther westward; and he hoped before many years that similar observations would be established on several other high peaks, in Cumberland for instance, or Snowdon or some adjacent hill, and on one of the highest "tors" in Dartmoor. The expense was not absolutely prohibitive; as they had heard £5000 was sufficient, and that might be given either by united contributions, or by some rich man who felt interested in the subject. At South Kensington they could see what private munificence could achieve for public objects; there were magnificent collections of pictures and works of art given to the country by private individuals, and it might be hoped that when the utility of upper stations, such as that on Ben Nevis, was once established, men of wealth would come forward to support similar establishments in other parts of the country. In connection with the Fisheries Exhibition at any rate it behoved them all to remember that though fish formed a very useful article of food, they were very often, in the words of the poet, "lives of men."

The motion having been carried unanimously,

Mr. SCOTT, having thanked the meeting, said he was very glad to hear of the good prospects of the Ben Nevis observatory, but he had not time, seeing there was another conference to be held at four o'clock, to go into some of the questions which had been raised, such as the formation of a station at Rockall. He would conclude by proposing a vote of thanks to the Chairman.

Mr. JOHN S. DYASON, F.R.G.S., seconded the motion, which was carried unanimously, and the conference adjourned.

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INTERNATIONAL FISHERIES EXHIBITION, & 13, CHARING CROSS.

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED, STAMFORD STREET AND CHARING CROSS.

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